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FACTORS INFLUENCING THE SETTING UP AND DEVELOPMENT OF THE IRON AND STEEL INDUSTRY IN THE LESS DEVELOPED COUNTRIES

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FACTORS INFLUENCING THE SETTING UP AND DEVELOPMENT OF THE IRON AND STEEL INDUSTRY IN THE LESS DEVELOPED COUNTRIES

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INTRODUCTION

Steel is and will remain for a long time one of the main needs of our civilisation. In spite of all changes in the development of economics, effected by the application of new techniques, the demand of steel increases, especially in the countries with higly developed industry even when steel is replaced by other materials (other metals or plastics).

The growth of the claim for steel is proportional to the growth of industrial production and was in the West-European countries in the years 1950 to 1959 in accordance to the industrial growth, which amounted to 5.9 % a year. Contrary to this fact, the growth of steel consumption was in U.S.A. in the same period only 0.26 %, whilst the increase of industrial production was 3.5 %. Here the increase of steel consumption was not in accordance to the industrial production in consequence of an other industrial structure.

Generally we may say, that in normal peaceful production programme the covering of economical requirements is in connection with the increase of steel consumption and this production will remain for a long time an index of the rising life standard of the population.

In the East-European Socialist States the increase of steel production is much more rapid than the industrial production and the annual average of the steel increase in the same period was about 10 %.

It is evident, that the growth of steel production is not unlimited. The index of growth will be higher in the countries with a low consumption per capita and lower in the countries with a high consumption.

It may be assumed that the steel consumption per head in technically developed countries will not overpass 1000 kg per year during the next twenty years. Some countries have at present already reached and even overpassed the limit of 500 to 600 kg in the steel consumption per capita.

Regarding the structure of requirements for steel materials it is evident, that the less developed countries will have a different structure in comparison with the more developed countries and they would claim for realization of constructions, which the more developed countries have made long ago. So it could be expected, that they will have relatively greater demands for rails and railway materials, commercial steel and similar products.

1. ANALYSIS OF THE CONSTRUCTION OF THE IRON AND STEEL INDUSTRY IN THE LESS DEVELOPED COUNTRIES

The less developed countries will not be able to realize the complete building u of their states at once, they would be obliged to proceed it in stages. It will not be possible for them to make use of the European method of building, which had the origin in small factories. But it will be a great advantage in the building of their industry, that they could make immediately use of the modern production technology and so overpass the whole evolution period. On the other hand, a great obstacle will be in high production costs. This will be very much

dependent from the capacity of the equipment. In the countries with large developed techniques production units with capacity of several million tons yearly production are at present built, so that it is not possible for each country, even with large developed industry, to build such works. For the manufacture of all kinds of steel materials i.e. commercial bars, rods, sections, rails, sheets, tubes, wires as well as special and high qualities, castings and forgings, the country should produce 18 to 20 million tons of steel ingots a year, The moder n today's high capacity steel mills require such a high steel production. With a production of 500 kg of steel per head and with fulfilment of the other conditions it would be production of a country of 40 million inhabitants.

If we only consider the demands and not the production conditions we draw the conclusion, that the countries with less than 40 million inhabitants cannot during the first stage of their construction build up modern iron and steel plants with full production of all steel products.

Such iron and steel plants could be built by countries having material and technical conditions and over 40 million inhabitants (China, India, Indonesia, Brasil). A large number of the less developed countries have not such a population, even when they possess all the conditions for building up an iron and steel industry. For such countries it will be necessary to group together for the mutual cooperation and to build this industry in the area, where the economical conditions will be most favorable. But it does not mean, that the smaller, technically less developed countries should remain without metallurgical bases.

It could be summerized, that the small, less developed countries must cooperative for the building of their iron and steel industry in order to install the modern integrated iron and steel plants.

Non-integrated iron and steel works can be built for each country in the limits of national needs and possibilities. The erection of the iron and steel industry, especially of integrated type, would mostly be carried out on the seacost or in the area of a navigable river with economical possibilities, except the cases, when a material and technical basis for building such an industry is in inland.

2. MATERIAL-TECHNICAL BASIS

For the decision concerning the building of new iron and steel plants is deciding - the material-technical basis, i.e. raw material, fuel and power basis, economy of transport and available man power.

The raw material basis must be reliably specified about quantity and quality. The same provision should be applied for the fuel basis. Before the construction of integrated iron and steel works (i.e. with blast furnaces, coke plants, steel plants and rolling mills) the following must be determined by the geological research: o r e m i n i n g m e t h o d - if it will be mining in quarries or underground, i r o n c o n t e n t - detailed c h e m i c a l a n a l y s i s - especially content of undesirable elements such as P, S, As, futher content of other additional metals, especially Cr. Mn, Ni and other compounds such as SiO_2, Al_2O_3, CaO etc. - p h y s i c a l p r o p e r t i e s of the ore, whether the ore is easy or uneasy to reduce, lump ore or powder ore, o r e r e s e r v e s etc.

The iron-ore for the modern iron and steel works must be principally concentrated and dressed. The concentrate should not have a lower content of Fe than 60 % with a minimum of SiO_2. Content of P, S, and As must be reducible on minimum. These elements, especially P,

determinate the future technological process. As in a great quantity makes the ore unworkable.

The integrated iron and steel works can be built on a or base with ore reserves for about 50 years. The quantity of the annual mining should not be larger than 1.5 % of reserves.

The fuel base is in the standard technology important for the production of coke for blast furnaces. This coke makes an important item. Natural gas is one of the most important factors, as it can be used for blast furnaces, melting and heating furnaces and as a power resource. Therefore the geological research of natural gas must be also carried out.

A deciding factor for the ore and fuel base is the possibility of economical transport. Here will be deciding if the basis is in the area of a river, railway or road. Thickness of the ore or coal deposits establishes the economy for the construction or the transport ways.

3. UTILIZATION OF THE FUEL AND POWER BASIS

The integrated iron and steel plants must be designed for the minimum of solid consumption. Coke for blast furnaces cannot be at present entirely substituted by liquid or gaseous fuels. Oxygen enriched natural gas or the injection of oil through blast furnace tuyeres will decrease coke consumption in the blast furnace up to 400 kg per ton of pig iron. The U.S.A. and U.S.S.R. using concentrated ores or pellets have at present a consumption of 750 kg per ton of pig iron. This fact will economically influence the location of the metallurgical works. Without the use of natural gas or oil, and without the use of concentrated ores it is necessary to transport 1250 kg of technological coal per ton of pig iron. With the use of natural gas or oil only 670 kg. Natural gas or oil reduce considerably the transport costs and consequently the production costs. The use of natural gas or oil not only in blast furnaces but also in melting and heating furnaces should become a principle in modern iron and steel works. There is an exception if the plant is built on the base of solid fuel.

The use of these fuels will considerably reduce the investment costs because the coke plants could be constructed with smaller capacity and the cost of material handling in the plant will decrease.

If there is an abundance of natural gas or oil a power plant for the production process steam may be constructed with maximum of a third part of electric power.

Application of the natural gas and oil system will not involve special investment. Natural gas can be conducted even for a distance of thousands of kilometres. As the less developed countries are mostly in warm zones the oil system will be less complicated.

As above mentioned, the integrated iron and steel industry could be built with economics with the help of the planned cooperation and division of production schedule by the countries united in pursuing this aim - and thus in stages.

In the first stage of construction it seems to be advantageous to reach for the mutually cooperating countries with small numbe of inhabitants a production of 150 kg of steel per head. The same applies for each independant country with a greater numbre of inhabitants. The countries associated for their mutual economical aid could made a complex of states of 60 to 80 millions and even more inhabitants and should produce in the first stage approximately 12 million tons of steel. This production corresponds to the errection of three modern integrated steel works. These plants should be specialized each for a different

kind of production and each work should be completed by corresponding steel consuming shops. One work should produce sheet coils, other shapes, sections and rails and the third strips, wires and sections. The construction should be realized in the countries with the best economical conditions (raw materials, market). Neither these three integrated plants would be necessary to build simultanously. For their construction to the full capacity it would be pressumed an investment cost of 1.500 - 1.800 million dollars + 45.000 workers.

The building of the I. stage with the setting up of the particular production units to full capacity would last 8 years from the date of the regular placing of the order. It would also be necessary to organize a training of one third workers of all categories in the more developed countries; it would be necessary to staff the key positions during the first 2 - 4 years of running in by cadres from the supplying country.

In the second stage the annual production of 20 million tons of steel should be reached, which would correspondent to the present level in the Polnish People's Democratic Republic. In this stage high quality steel and every kinds of metallurgical production (wires, pipes, rops) could be produced.

New techniques and production processes could be applied to the full extend in these new integrated iron and steel plants.

For the coke production should be used batteries with great volumes, with 30 m^3 chambers, for the pig iron production 2000 m^3 blast furnace: with a burden of 100 % self-fluxing sinter or self-fluxing pellets, with a complete automation in burden preparation and in proper technological process and in power system.

As melting units could be used great volume SM-furnaces with the content of 200 t to 400 t and with oil heating or oxygen converters of 150 to 250 tons. Casting could be produced in ingots up to 24 tons from semi-killed steel and with a raised metal output. For blooming and slabbing mills the most moder electrical equipment with shortest reversing times should be used. In the case of a convenient arrangement of roughing and continuous wide wide strip mills the output possibility could reach up to 5 million tons a year.

It would also be possible to install continuous casting, especially for the production of slabbs and so obtain better economical results.

Rolling mills would be fully automated and would secure the highest quality products with highest productivity.
The capacity of such a rolling mill would overpass annually 1 million tons of finished products.

The mutual cooperating countries could anticipate large cumulation of orders, which would be able to make the best utilization of the production units and in consequence of it to cut the actual production costs.

The integrated plantsas industrial assemblies might even become regional power plants, gas works and material technical bases for futher work out shops, which would, according to the plan, use products of the integrated iron and steel metallurgy. So could be erected in the area of the coke plant a unit for sulphuric acid, for the utilization of chemical byproducts such as tar, phenol, naphtaline and ethylen.

Slag from the blast furnaces could be utilized for the erection of an integrated construction plant.

N o n - i n t e g r a t e d i r o n a n d s t e e l w o r k s have usually scrap as material-technical basis. But they can use

even other row materials, such as lumps or sponge iron. As regards the scrap basis, this will be unsufficient from the own sources in consequence of low consumption of steel in the less developed countries and these countries would be under the necessity to buy the scrap or to produce lumps from the own poor iron ores and these to smelt either in open hearth or electric arc units of furnaces. Such steelworks may have the smelting units up to 100 t capacity and produce 500,000 - 1,000,000 tons of steel a year. In the case, that they possess available sources of cheap electrical power, they will build melting shops with electric arc furnaces, in case of available oil or natural gas, they will build melting shops with with open hearth furnaces.

This conception may advantageously use the continual steel casting process to spare the blooming mill costs and to obtain a higher utilization of steel up to 8 % and also higher economical results of the production.

As regards the non-integrated iron and steel works, the high capacity rolling mills cannot be here considered. As these units have a relative low capacity, they will not produce at such low costs and such a high productivity as the rolling mills in the integrated steelworks. But they will have an other advantage in the fact, that they will easier roll all the coming orders and produce more economically all the small amounts of rolling materials, which will be surely very required. An other advantage of non-integrated works is, that they can produce also special steels.

Investment costs of such a non-intergrated plant with a capacity of 800,000 tons a year would make approximately 70 to 80 million dollars; the need of workers would be about 2500 to 3500 of man power in accordance with the difficulty of the orders to be produced.

These works could be a good workmen school for the large integrated steelworks. The erection time from the date of order to the date of full production would be 5 to 6 years.

4. ANALYSIS OF ERECTION POSSIBILITIES

For the building of the iron and steel industry it must be appreciated that before solving the conception problems there must be made a detailed geological rechearch. The results of this labour must be considered in the general plan of development of the national economy of the country.

For the erection of the integrated iron and steel plants both is absolutely necessary for every country taking part in the mutual economical cooperation. Besides that, it is necessary to build the whole developing plan of mutual cooperation with delimitation and specialization of the production.

This plan must determinate the country in which the industry is to be established and time delimitation of the building up of the individual stages. Based on this general plan of the development a detailed study of the development of the iron and steel industry must be worked out. Project of the individual steel works must be worked out including economical computation in several alternatives of their location. The study must allow for erection in stages, for a possible futur extension of the work and also for a future introduction of new techniques, which cannot be put into reality at the time, when the erection begin.

As soon as one of the alternatives has been choosen it is possible to proceed to a more specific projection work. Czechoslovakia has experiences and in the projection institutes also a sufficient designing capacity for the working out such designs since one

industry plant has been bult and completed on the basis of the project of this institute and the secon one is under construction now. Apart of this a number of reconstructions have been worked out. Needless to say, that this was done with the aid of the industry of Czechoslovakia. Czechoslovakia has his own experiencies with the erection of coke plants, blast furnaces, roll killns for lumps, ore and coal dressing plants, sintering plants, open hearth and arc furnaces, melting shops, some rolling mills especially for sections and strips, founderies, welding and forging shops inclusively power plants.

If the interrested country decides for the establiahment of the non-integrated industry it is not indespensable to link up its development plan with the others countries, interrested in economical cooperation. In this case also the geological survey will not be indespensable.

The erection of non-integrated steelworks would be praktically limited on the building of a steel shop and rolling mill shop with a simple power plant and transpot equipment.

In designing such works it could be relatively soon approached to detailed designs. The whole erection time is here practically three years shoter. Also here can be applied erection in stages from smaller to bigger furnaces. There could be applied also some reconstructed rolling mill equipment, especially in countries with abundance of worker. In the later erection such works can be reconstracted for producing special steels, what must be kept in mind in the designs.

In the developed countries there can be also applied some new proved technological processes as oxygen converters, high capacityfurnaces, heavy ingots, semikilled steels, oxygen, oil, natural gas and automation.

But a contemporary erection of special steel work cannot be advided. Such works must be considered in the third stage, as the special steels lay great claims to technical ability of skilled worker.

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